Space Weather Technical Forecast

Issued on Saturday 23 November 2024 at 12:30 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate Solar Activity

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with two M-flares, peaking M1.6 at 22/1546 UTC from AR3905 in the southeast. M1.0 flare was also observed from AR3906 near the southeast limb. These are the most complex regions on the disc, with AR3906 seeing complex looping above the region and potentially having a delta spot, although this is currently difficult to confirm due to its viewing angle. The other regions on the disc are all smaller and simpler.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Slow wind regime persisted through the period. Solar winds speeds measured by ACE at L1 were background to slightly elevated at 370-430km/s, with density near average or just below. Interplanetary Magnetic Field (IMF), Bt, was Weak to Moderate, between 5-8nT. The north-south component was also Weak to Moderate and variable in direction, ranging between +7nT and -8nT. Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 eased after the enhancement on 21 Nov. The >10 MeV flux was at S1 at the start of the period, before rapidly declining to the current background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background. The associated 24-hour fluence remained below Active, with 2.32e6 total pfu observed at 23/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with further M-flares expected, and a slight chance of an isolated X-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Slow wind conditions are expected to dominate, but with a chance of slightly elevated solar winds from any connection to the fast winds of CH93, or more likely CH94. This most likely to occur on day 2 (24 Nov). Geomagnetic activity is expected to be Quiet to Unsettled overall, but with a chance for spells of Active, mainly day 2 (24 Nov).

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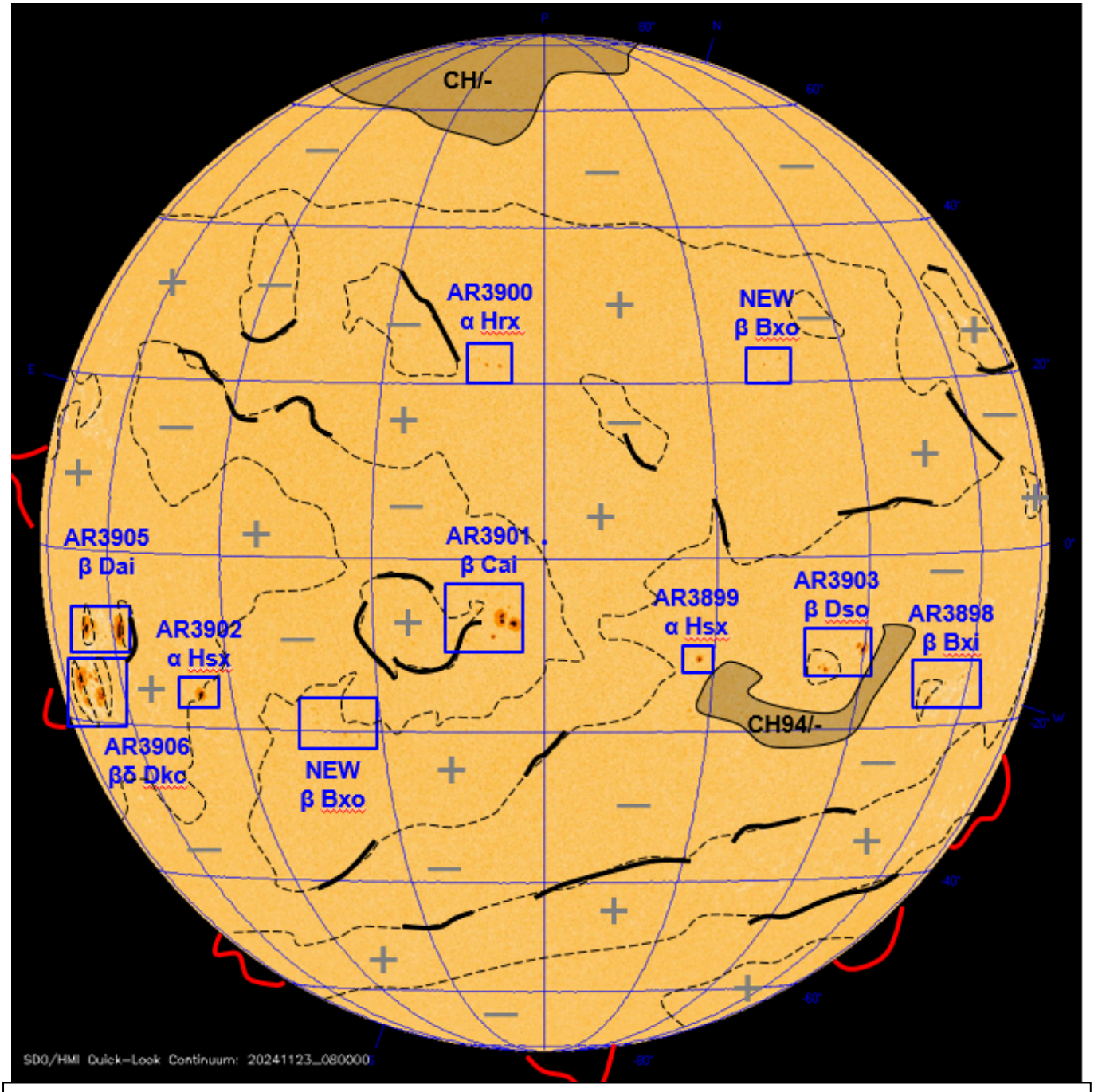
Energetic Particles / Solar Radiation: High energy protons are expected to persist at background, with only a very slight chance of enhancement from any of the regions currently on the disc. High energy electron flux is expected to be mainly background with the associated Active fluence remaining well below the Active threshold.

Figure 1: Solar analysis map - valid 23/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are currently no Earth-directed CMEs.

The coronal hole forecast is currently low confidence, as both CH93 and CH94 are becoming harder to see due to the building of coronal magnetic loops, while MOSWOC Enlil continues to over-estimate the current conditions. Furthermore, persistence from the previous rotation is contaminated by two CME arrivals. Given the time of year, and the weak appearance of the coronal holes any enhancement during the coming days is expected to be weak, perhaps most likely to occur on day 2 (24 Nov) from CH94 which is slightly larger and further east.

Geomagnetic activity is expected to be Quiet to Unsettled overall, but with a chance for spells of Active and a very slight chance of reaching G1 Minor storm, perhaps most likely on day 2 (24 Nov).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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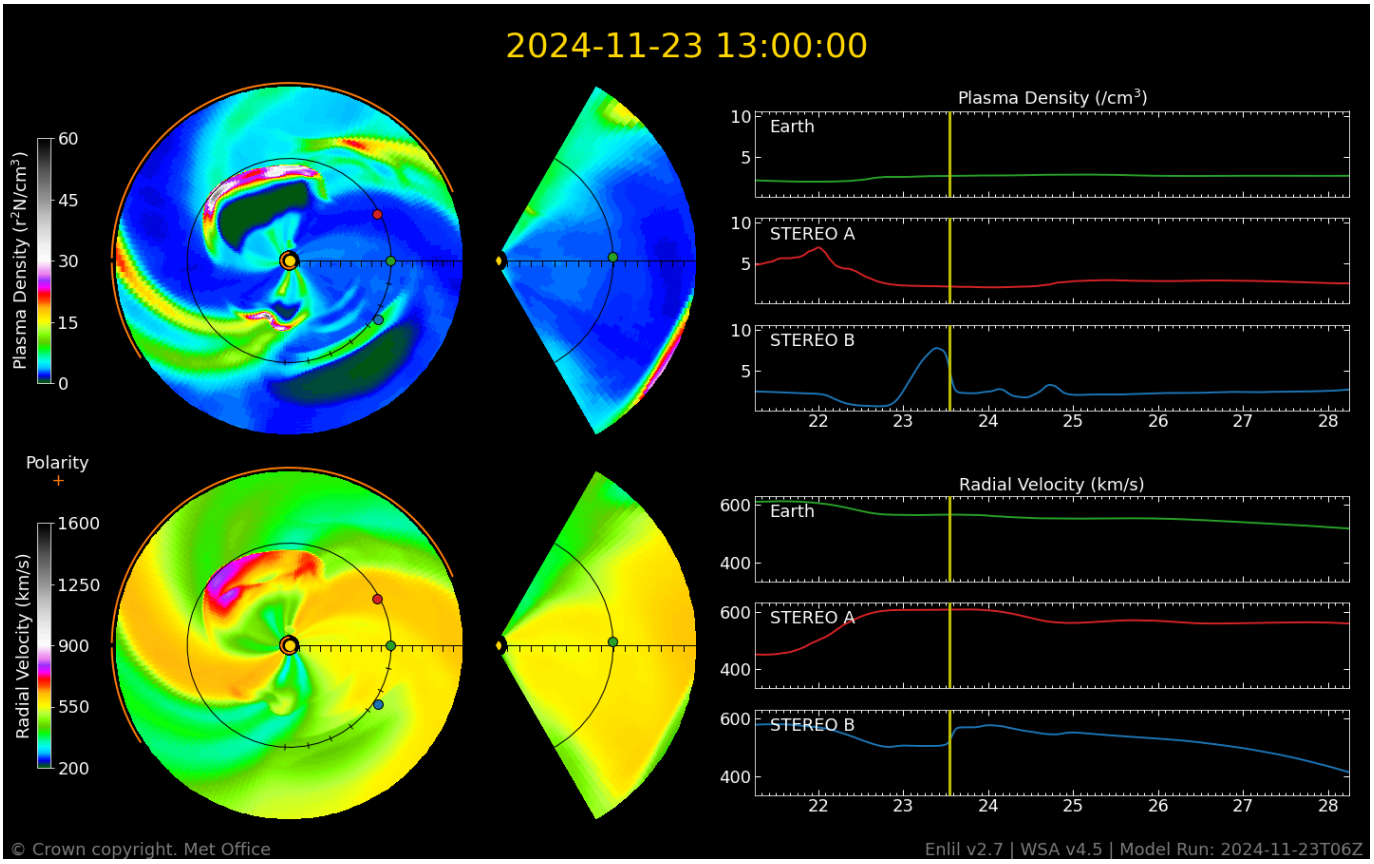
Figure 2: Enlil, showing a large and broad fast wind which is currently not observed.



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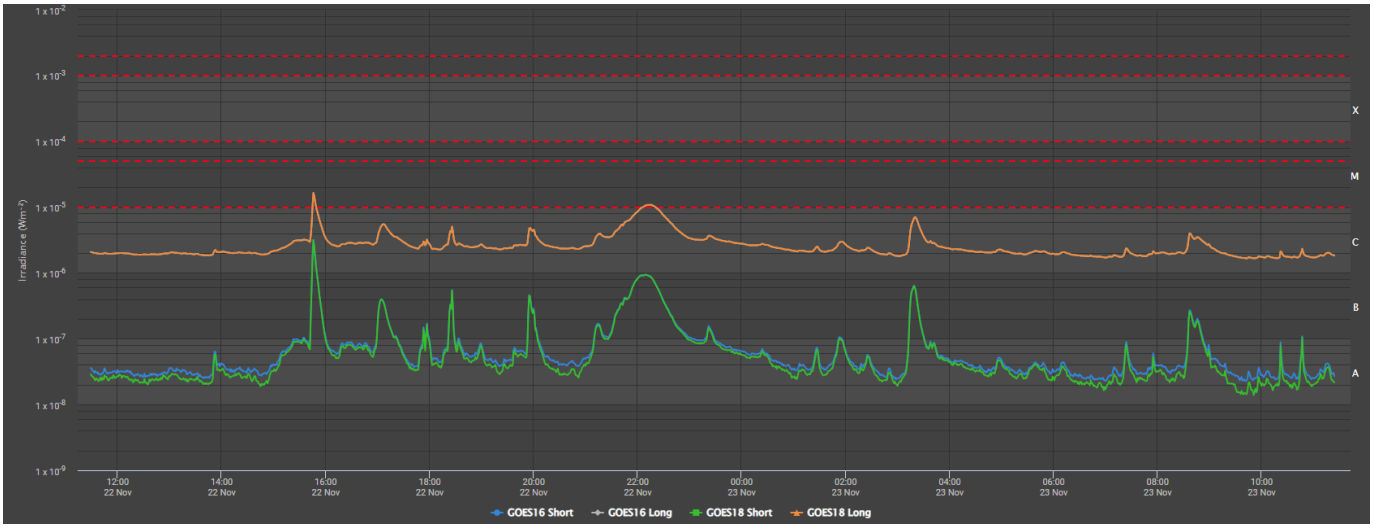
Radio Blackouts - X-Ray Flares

Solar activity is currently Moderate and expected to continue Moderate to Low, but with a slight chance of X-class flares, primarily from AR3906 in the southeast.

There are currently ten active sunspot regions on the visible disc. The most notable are the two new regions rotating onto the southeast limb. In particular, AR3906 appears to have a notable trailer, set within plage and with further areal growth and complexity likely to become apparent as it rotates into view. The magnetic structure of this spot is currently impossible to accurately ascertain due to the viewing angle, however there is potential for a reasonable strength delta spot, and this has been tentatively assigned to it. AR3905, to its north, appears to be magnetically simpler, as an E-W aligned bipolar spot, however this is a moderately sized spot that continues to increase in areal extent as it rotates into view. The spots across the rest of the disc are generally relatively small and simpler, with no sign of notable growth, although a bright area over the northeast limb in SDO AIA imagery suggests further a region or regions may rotate onto the disc.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: GOES 16-18 X-Ray flux trace.



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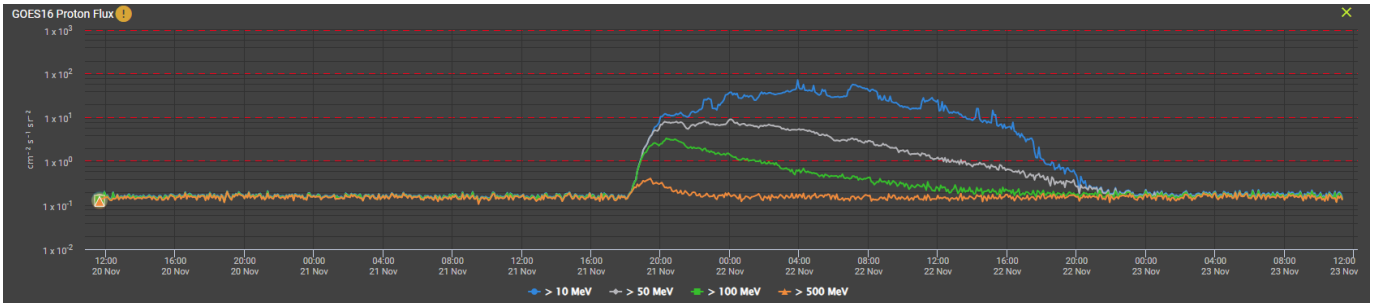
Solar Radiation Storms (High Energy Protons)

The recent enhancement to the GOES-18 Proton flux has now declined to background. This enhancement occurred due to a large eruption from over the west limb on 21 Nov, and was a relatively hard event with responses also observed in higher energy channels, including >100 MeV and >500 MeV. The likely source region, while impossible to observe and assess if it survived this event, could potentially produce further notable eruptions. However these are increasingly unlikely to influence Earth if they occur.

The regions currently on the visible disc are currently unlikely to produce observable proton events, with the most likely flare sources currently near the southeast limb. The observed proton Flux is subsequently expected to continue easing to background, and then persist at this level.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	5	5	5	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES 18 Proton Flux 21-22 Nov for a number energy channels. Hard enhancement late on 21 Nov has now eased to background levels.



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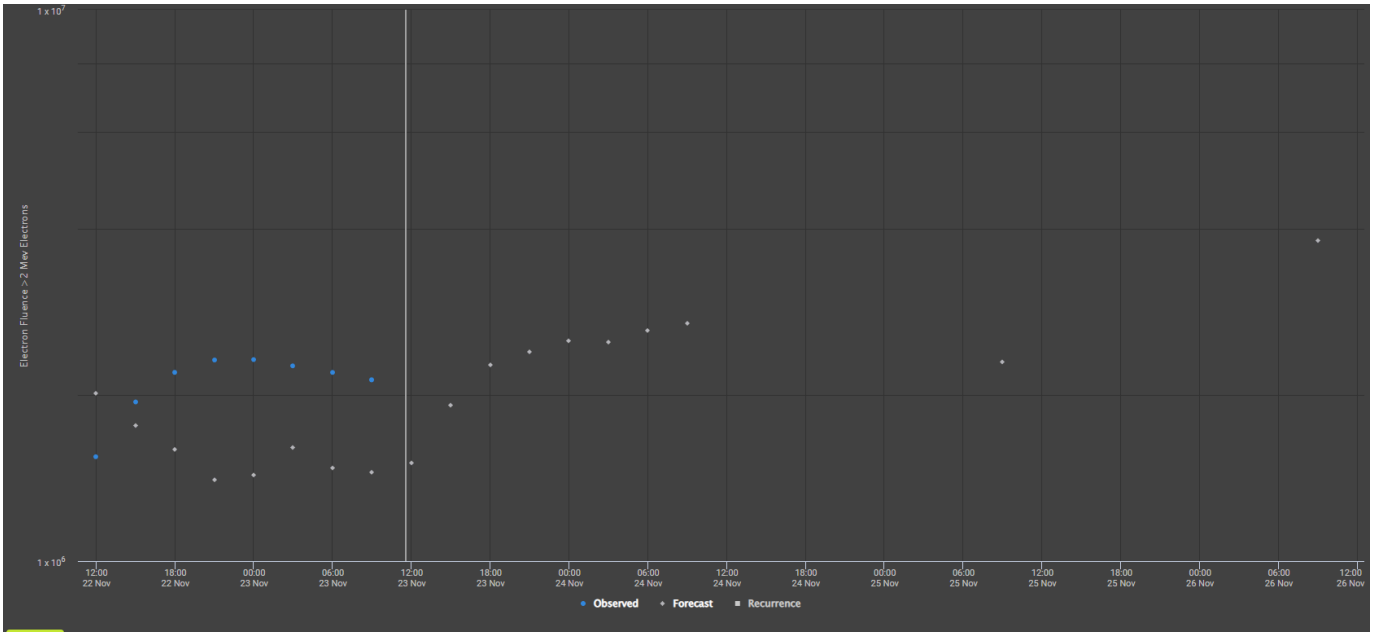
High Energy Electrons (≥ 2MeV)

Electron flux observed by GOES-16 at GEO has been at background, and is expected to persist at this level, with only very slight increases possible from any weak connections to the fast winds of CH93 or CH94, most likely later in the period.

The associated 24 fluence is expected to persist well below the Active level, with REFM providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

Figure 5: GOES-16 24 hr Electron Fluence and REFM



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